

THE
PURSUIT
OF
EXCELLENCE



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by
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JAMES CUNNINGHAM, SON & Co.

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JAMES CUNNINGHAM, PRESIDENT 1838-1886

FOREWORD

This is the story of a firm, James Cunningham, Son and Company, that once made carriages and now makes crossbar switches. Founded in the days of handicraft, the firm survives — and prospers — in an era so new that most of us have not yet caught up with it: the era of automation. Moreover, Cunningham has always been owned and managed by the members of one family. Its fourth president is the great-grandson of its first. But something more than a name has survived: the firm has spanned the Industrial Revolution without losing its essential character for quality production.

However, the history of a company, even as old a company as Cunningham, should not be presented without some explanation, for “company history” can mean anything from advertising to a statistical abstract of operations; as a form of reading matter it is suspect.

In the informal account that follows we have tried to avoid both bad extremes. Also, we have made no attempt to discuss the technical complexities of crossbar switching — or carriage making. This is a story for the ordinary reader. If we succeed in interesting him, it is because we have a story to tell, something more than a mere succession of events. There is a connection between making fine carriages and making crossbars.

I THE ERA OF OPTIMISM

THE story begins in 1833, when James Cunningham first came to the United States. He was eighteen that year, a large and strong Scotch-Irishman from a Canadian farm, making a visit to an uncle in New York City.

It was a leisurely journey he made, by sailing packet across Lake Ontario and then by slow stages from Rochester to Albany and down the Hudson Valley; it gave him a chance to appraise the country he was seeing for the first time and to recognize that his future lay here.

It was an optimistic and restless country that he saw. Andrew Jackson was in the White House, and his accession to the Presidency had been in the nature of a revolution; it marked the beginning of a new era. Especially in the West there had been a liberation of the hopes and energies of young Americans. The country between the Appalachians and the Mississippi was no longer frontier; the frontier was now beyond the Mississippi, and Westerners had taken over from the conservative politicians and merchants of the Eastern Seaboard; but the sense of new possibilities was everywhere. In the eighteen-thirties, more than ever before or since, America was the land of opportunity.

The opportunity was not so much to get rich quickly as to use one's talents. Most men expected to work hard; but in their work they would not be hampered by class barriers and rigid customs. There was an absence of governmental interference, for the Jacksonian revolution had done away with any notion that the United States would be developed by federal agency and according to plan. Moreover, there were no large, established industrial enterprises dominating the market place. On the other hand, there was sufficient civilization; there were a common language and tradition and the American instinct for co-operation among neighbors; these kept the surge of expansion from being merely anarchic, though it sometimes threatened to become so. There was a solid base for development.

James Cunningham was a fortunate young man. In a

climate of optimism he was not simply optimistic; he had a talent. Back in Ontario it had manifested itself as an interest in woodworking and designing, and he had already left the family farm long enough to work in a carpenter's shop in nearby Cobourg; but Canada in those days was sleepy, as the United States had been a generation ago, a country for farmers and small craftsmen who clung to the methods they had been taught as apprentices. James' talent demanded something more than a repetition of old techniques. Exactly what this was he could not have said, but his journey to the United States was essentially a search for it.

Probably he hoped to find a job in New York City with his uncle, who was an architect. If so, he was disappointed. At any rate, after a short stay, he made his way back toward Canada through the raw towns that lined the Erie Canal and came again to Rochester, and it was here at last that he discovered what he had been looking for. One Matt Brown had set up the first machine shop in Rochester, in 1830, and by 1833 there were others, producing farm and factory tools.

The power machinery they used was primitive, produced rather out of the Yankee instinct to tinker and improvise than because of economic considerations. It was inefficient. Craftsmen were distrustful of it. The merchants of the day, who were learning to become capitalists by dint of subsidizing the craftsmen, were skeptical as to its usefulness. Moreover, it was not suited to fine woodworking. Power-driven saws, planing and grooving machines, mortise and tenon machines would not come into use for another fifteen or twenty years, but James, lingering in Rochester, doing odd jobs, caught the connection between the potentialities of the new machinery and his own talent.

Before he sailed home across Lake Ontario, he had the promise of steady work. Messrs. Hanford and Whitbeck, entrepreneurs and more optimistic than most, were in process of setting up the first coach-making shop in Rochester. It would open next year, in 1834.

The family James returned to consisted of a widowed

mother, a sister, and three older brothers. Arthur Cunningham, his father, had died when James was only four.

They were Scotch-Irishmen from County Down, in northern Ireland. The oldest brother had come to New Brunswick in 1824 and made enough money there to bring the family to America in 1831, when James was sixteen. They settled on a farm near Cobourg, and eventually they prospered: the locality became a hamlet and took on the name of Cunningham Corners.

They were not farmers by inheritance. If they had been, they might have been less sympathetic with James' ambitions. Men on a new farm could not easily have dispensed with the services of a strong and healthy boy, however much talent he had for woodworking and however much he wanted to travel; but their father had been a theological student and their mother's father a Presbyterian minister: they were men of the class that "carried the sinewy tradition of Scotch intellectual life through the disappointments of northern Ireland," men with a respect for learning and for serious ambition. Their characteristic virtues were perseverance and a stubborn insistence on good workmanship, mental or manual.

James inherited these characteristics along with his talent for design. He would need them, for although he prospered, it was always by dint of hard work. Things never came easily.

Rochester, when James returned to it in 1834, was a town of ten thousand people. Although it received its charter as a city that year, it was far from having attained its permanent character. Its leading citizens were small independent proprietors: merchants and flour millers for the most part. It was almost untouched by the factory system, which was only beginning to develop in the United States. Three-quarters of its population had arrived within the last five years. Labor turnover was extremely high. Dissatisfied or merely restless young men could always move farther west. Harsh debtors' laws were an added incitement; but, if only because of the ease of migration, those men who stayed were

apt to be steady and hard-working. Generally, they were plain, practical men, native Americans in the Calvinist tradition, having the Yankee gift for improvisation.

From 1834 to 1838 James worked as an apprentice and journeyman for Hanford and Whitbeck, and then, being twenty-three years old, he formed a partnership with two of his fellow-workers, James Kerr and Blanchard Dean. Together they bought out Hanford and Whitbeck, taking over their premises. In that same year James married.

It was not an ideal time to launch a new venture, for there had been a financial panic in 1837; but the effects of the long depression that followed it were not felt until 1839, and James and his partners were producers, not financiers, and they were anxious to get to work on their own.

The little firm turned out cutters, better known as one-horse open sleighs, and buggies.

The buggy, which is simply a small, light carriage, was America's most characteristic contribution to coach-making. Its necessary merits in a country of long distances and primitive roads were lightness and durability; but even the first of the buggies produced by Kerr, Cunningham, and Company added to those merits a certain elegance. The design of its hood would reappear in the bonnet of a Cunningham automobile ninety years later.

However, the excellence of its products was not enough to guarantee the success of the partnership. By 1842 the general depression was at its lowest point, and the firm was in debt for more than six thousand dollars.

Kerr and Blanchard resigned, and James Cunningham assumed the entire debt, borrowing the money to do so at an interest rate of 18 percent a year. He was then twenty-seven, with a wife and three small children. Given his experience and talent he would have had no trouble finding a secure job as an employee, but he was one of those men who need to be their own masters, and he had a passion for making fine carriages.



CARRIAGE FACTORY AND SHOW ROOMS - 1882

II FROM CARRIAGE SHOP TO FACTORY

NOTWITHSTANDING its load of debt, the firm grew. If James was no financier, he was aware of markets, and he looked to the West. Half a century later the Cunningham company would produce four-fifths of all the carriages sold west of the Mississippi. But the West of 1842 lay almost at James' doorstep. He began modestly, often hitching up a string of buggies and traveling through the upstate New York countryside, from Rochester to Niagara Falls, demonstrating and selling his product. The large, agreeable young man, slow-spoken and entirely confident of himself, inspired confidence in his customers. More often than not, he would return home on horseback: the indication of a successful selling trip.

His main problem was to build a reputation. A multitude of small carriage-making firms had sprung up in the new West; it was a rich field for exploitation. Advertising was common in the forties and fifties of the last century, but most of it was too crass to be persuasive; moreover, it was carried in newspapers with small circulations. For James' purposes, a better means of publicity were regional fairs, where the product itself might be seen. He relied on them rather than on newspapers. Mostly he relied on the obvious superiority of his products.

For all its picturesqueness, the era between 1830 and the Civil War was one of shoddy goods and slipshod mechanics. This is not to deny honorable exceptions, but for the most part craftsmanship had gone out with the Jacksonian revolution. The Yankees who built the new railroads and machines were eager and ingenious rather than painstaking. Even in that immensely optimistic age people were sometimes troubled by the frequency with which locomotives were wrecked and steamboat boilers exploded. By and large, standards of workmanship did not rise until the end of the period, with the arrival of slower-paced, more thoroughgoing immigrant mechanics from Great Britain and Germany.

As a consequence, James Cunningham was in a nearly

unique position. Excellence stood out. Moreover, a carriage was too expensive to be bought without deliberation and some assurance of its merits. A good rig attracted attention in any small community.

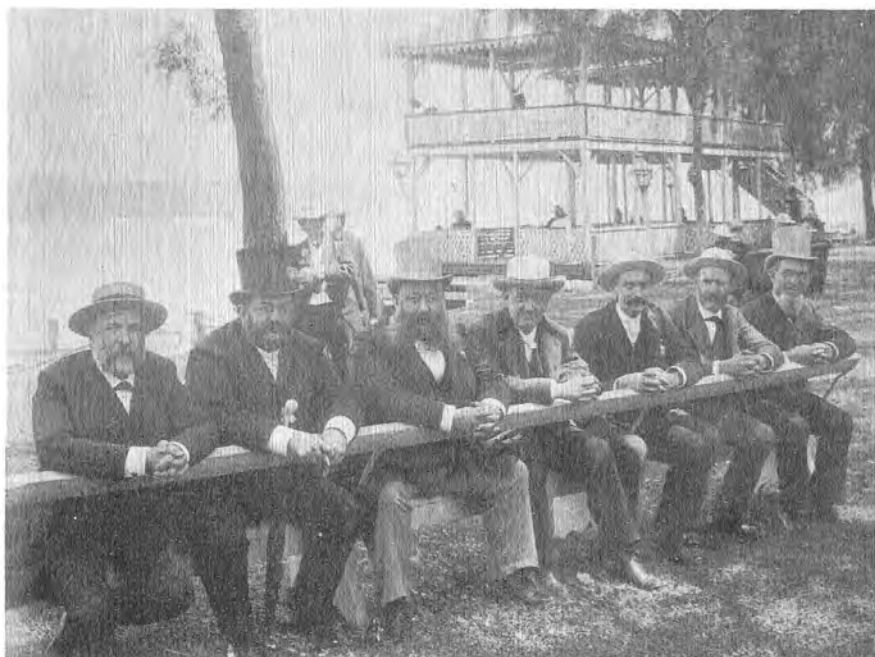
Significantly, not all the customers were private individuals. Until the advent of the automobile, the livery stable was an important feature of every town, and proprietors of livery stables had a shrewd eye for good carriages. James cultivated good relations with these men. A man who hired a Cunningham carriage from a livery stable and liked it might eventually buy one for himself.

The business grew, to such an extent that in 1848, when the original carriage works burned, James was able to replace it immediately with another. The new factory was built on Canal Street, in Rochester, a little farther west than the first, and in the manner of those times James built his house next to it. In succeeding generations American industrialists would make a separation between their working existence and their leisure, but James, like most artists and craftsmen, wanted to live with his work. He never developed a set of independent interests.

By the early fifties his reputation had spread as far west as Illinois. The Rochester *Democrat* in 1852 published an account of a carriage built for an unnamed 'gentleman from Chicago' whose price was \$1,000. Sixty years later, another Chicagoan would buy a Cunningham automobile for \$15,000; but a price of \$1,000 was tremendous for those days, being about three times as much as an ordinary carriage sold for.

'Mr. Cunningham,' the account concluded, 'turns out none but the best work, and the fact is becoming known abroad pretty extensively.'

In 1853 a modest insertion in the Rochester City Directory advertised 'Cunningham's Coach Factory. Fifty Hands Employed. All My Own Work.' The last phrase meant that, characteristically, James produced his own axles, springs, wheels, and such accessories as folding steps and lamps. Most carriage makers bought these from proprietary firms.



COMPANY PICNIC, IRONDEQUOIT BAY, 1900
Joseph Cunningham (fourth from left), President 1886-1909

It would be a mistake to think of the establishment as a factory in the modern sense. There is no exact modern parallel. It resembled not so much the flour or cotton mill of those days as an architect's office or a technical school. Nor were the 'hands' employees, as we now use the word. They were apprentices and journeymen, and none of them expected to spend the rest of his life working for wages. The aim was to become an independent proprietor or master, as James had done. The 'factory' was a training school and a means of making and saving money for an independent career. Moreover, even the small independent proprietor dreamed of retiring from business by the time he was fifty. The ultimate goal in America before the Civil War was a place in the country: a farmhouse surrounded by eighty or a hundred acres of land. The ideal is depicted in the popular engravings of Currier and Ives.

There were other contrasts to modern times. From 1800 until the coming of the Civil War the wage-scale hardly changed: skilled labor got from one to two dollars a day; unskilled, about half that much; however, during that period the amount of goods and services that could be bought with those sums increased enormously. In 1850 a prudent workman might count on saving enough in a single year to buy a small farm, and for the less prudent and the dissatisfied there was always the possibility of moving farther west and becoming squatters.

The point is worth considering; it suggests some of the difficulties James Cunningham had to contend with in what is now called 'the field of labor relations.' Added to them were the difficulties arising out of his insistence on high standards of workmanship.

However, if the temperament of most native American workmen was unsympathetic to craftsmanship, it was receptive to invention. Unlike their British counterparts, American workmen did not try to sabotage the new machines.

Until the use of machinery became widespread, the merchant, rather than the producer, had dominated the mar-

ket place. The goods he sold were made either by household labor, as in the boot and shoe industry, or in small shops.

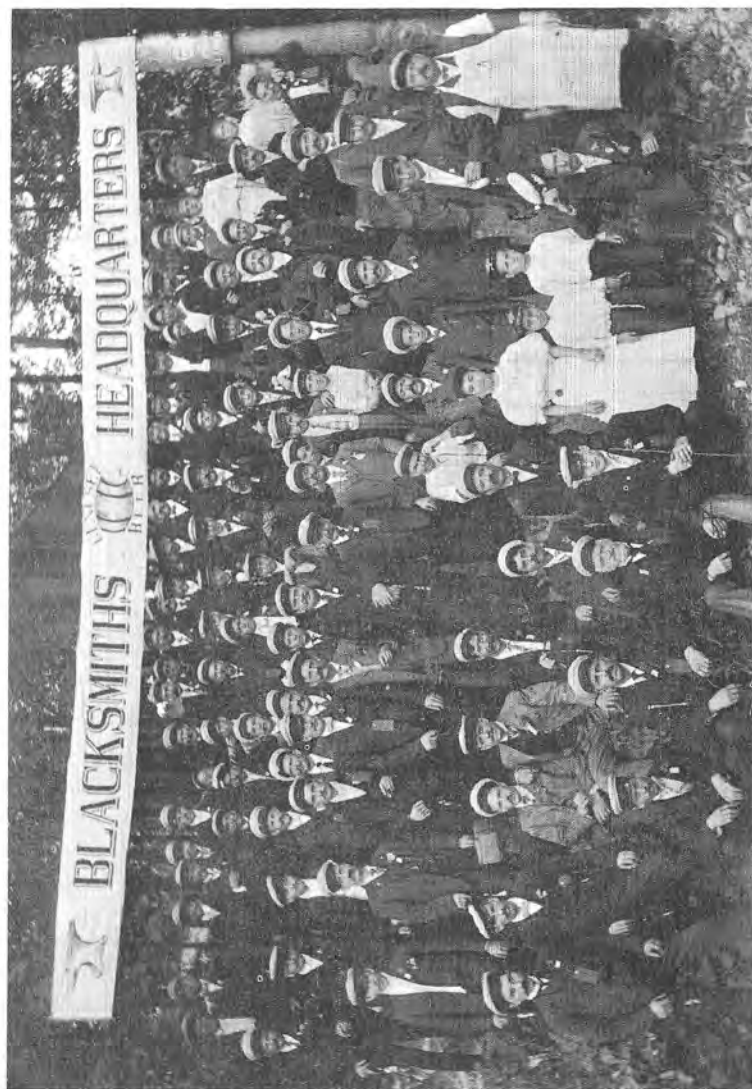
Machines changed all that. They were too expensive for the small independent producer, who had to expand, to become an industrialist, or to go to work for a more successful competitor.

By the late forties considerable machinery for wood-working had been introduced into the business of carriage-making. Already there were machine saws, which could work in curves as well as straight lines — and a good carriage is almost all curves. In the fifties there was a proliferation of other power tools. James Cunningham himself invented and patented some of them. With the expansion of his plant and his market he, too, was becoming an industrialist; but at the same time he was still the best workman in the factory.

It might be supposed that at last James' period of struggle to establish the firm on a solid base had come to an end. He was known and respected; he had a working-force of well-trained men and a wide market, — but in 1857 there was another financial panic in the United States, and its consequences for the company were temporarily disastrous.

The panic — and the depression that followed it — were mainly the result of the collapse of a railroad boom. More than 25 per cent of the active capital in the country was invested in railroads, and when these failed to show profits as soon as was expected the market collapsed. With its collapse came that of the banks, which had depended on railroad securities for their own collateral. The West, James' principal market, was especially hard hit. Every Western bank but one closed. James was forced into bankruptcy.

In this failure there was a compensating circumstance. Rufus Keeler, a former mayor of Rochester, was appointed receiver for the firm, and Keeler had a nephew, Rufus K. Dryer, who had been named after him. When reorganization had been completed in 1860, James Cunningham, as a favor to Mayor Keeler, hired young Rufus as an office boy and undertook to teach him the art of coach-making.



COMPANY PICNIC, BLACKSMITHS AND APPRENTICES, 1910

Rufus Dryer, born in 1846, was three years younger than James' son Joseph; a year older than James' daughter Margaretta, whom he would one day marry. He was an active, quick-minded boy, and, as it turned out, he had a talent for finance. It was a talent the firm would need and profit from.

By the time the Civil War broke out the company was back on its feet, and with the ending of the war, James was at last freed from the worries and uncertainties that go with founding an enterprise and getting it solidly established. He was free to make carriages, and the reward of his early struggles was twenty years of calm prosperity and expansion.

His son Joseph, born in 1843, became a partner in 1868. Rufus Dryer became a partner in 1875 and married Margaretta Cunningham in the same year. Joseph and Rufus were both men James could rely on. He never had the feeling so many founders have had, that his probable successors were impatient to change the institution he had made. His son and son-in-law were sufficiently tough-minded to resist the great temptation of the Gilded Age, which was to use a business enterprise as a mere occasion for speculation.

As a result, when the great crash came in 1873, to be followed by another long depression, the company was unaffected. Almost alone among Rochester firms it expanded, adding to its labor force and its plant acreage. By 1874 there were two hundred employees; at the end of the seventies, four hundred. There were 'repositories', which is to say, branch offices with display rooms, in Louisville, Nashville, Memphis, and New Orleans, in the South; and in Chicago, Des Moines, Kansas City, Topeka, Denver, and San Francisco, in the West. In 1876, Cunningham carriages and a hearse won prizes at the Philadelphia Centennial Exposition, — and Cunningham vehicles would continue to win prizes at every important exposition from then on.

If the years from Andrew Jackson to the end of the nineteenth century were marked by progress, — in science and invention, and toward social and economic stability, they were also years of a decline in taste and style. Architecture

became either heavy or flimsy, painting and sculpture merely genteel. The carriage stands almost alone among the artistic productions of that era. It maintained its elegance. It even represented an improvement in style over the carriages of the preceding century.

The history of the carriage is shorter than most people suppose. It does not really begin until the eighteenth century. Before that, wheeled vehicles, even the ornate coaches of state in which kings rode, were essentially wagons, ponderous and uncomfortable. Carriages, and even travel for pleasure, came into their own when coach-makers learned to make proper springs. Springs were important; rubber tires would not be invented until 1886, and pneumatic tires later still.

Once he had solved the problem of suspending his vehicles properly, the coach-maker turned his attention to body-making. Here his principal aim was to combine a large number of materials — iron, brass, woods of various kinds, leather, horsehair, wool, silk, glass — in a form that was both sturdy and elegant. Unlike modern automobiles, carriages were expected to last indefinitely. Elegance, as always, was a matter of good lines rather than applied decoration, but decoration was part of a carriage: the effect the coach-maker wanted was one of richness, not sparseness.

Color, too, was important. In an age whose taste ran to somber browns, the carriage was a glittering exception. A Cunningham landau made for President Cleveland in the eighties had green panels, black body with thin gold stripes, and a lining of green cloth. Other carriages might have red or yellow wheels. Polished brass fittings and varnished mahogany caught the sunlight.

Most styles originated in Paris. British and American coach-makers were inspired by books of colored plates from France — even the victoria was a French invention — but these style books told nothing of how to construct a carriage. Techniques of construction and finishing were secret, handed down from masters to journeymen, who in turn became masters.



PHYSICIAN'S PHAETON

The first vehicle built by the Company in 1838. It is shown here driven by Augustine Cunningham, President 1909-1957.



PANEL-BOOT VICTORIA, 1900

With the disappearance of the carriage, knowledge of most of these techniques has been lost, but we know enough about the process of finishing the body of a carriage to recognize that it was nearly identical to that of finishing the bodies of Cunningham automobiles in the next century. The process is not one that lends itself to mass-production or assembly-line methods.

The Cunningham company built not only carriages but also ambulances and hearses. Ambulances tended to be utilitarian in design; hearses, ornate and expensive. Even before the Civil War a hearse costing \$2,300 had been made for a Pittsburgh undertaker. Another, sold in the eighties to a Chicagoan, so impressed the buyer that he wrote to inform the company that he was having his entire premises redecorated in a manner befitting the sumptuousness of the hearse.

Prices ran from \$400 to \$2,500, and production of hearses became a mainstay of the firm; in the nineteenth century the impulse to celebrate important occasions with ceremonious formality took the place of the modern impulse toward informal play. "Having fun" was for children; adults enjoyed oratory and parades and ostentation. Funerals became fashionable, to such a point that in 1867 a bishop of Rochester was obliged to limit the permissible number of carriages in a cortege to twelve.

Nowadays it is hard to see how James Cunningham, having the feeling for elegance and clean lines that is manifested in his carriages, could have liked making these heavy, embellished hearses, cumbered with carved wooden draperies, tassels, columns, and garlands, but there is no evidence that he objected to it. As examples of wood-carving they were superb, and perhaps the designs were the equivalent for him of those drawings of impossible monuments and edifices in which architects sometimes indulge.

In January, 1882, there came an event for which the firm was not prepared. Organized by the Knights of Labor, the workmen asked for higher wages and a relaxation of the strict shop rules. What particularly aggrieved them was the

punctuality with which the gates of the plant were closed at starting-time every morning.

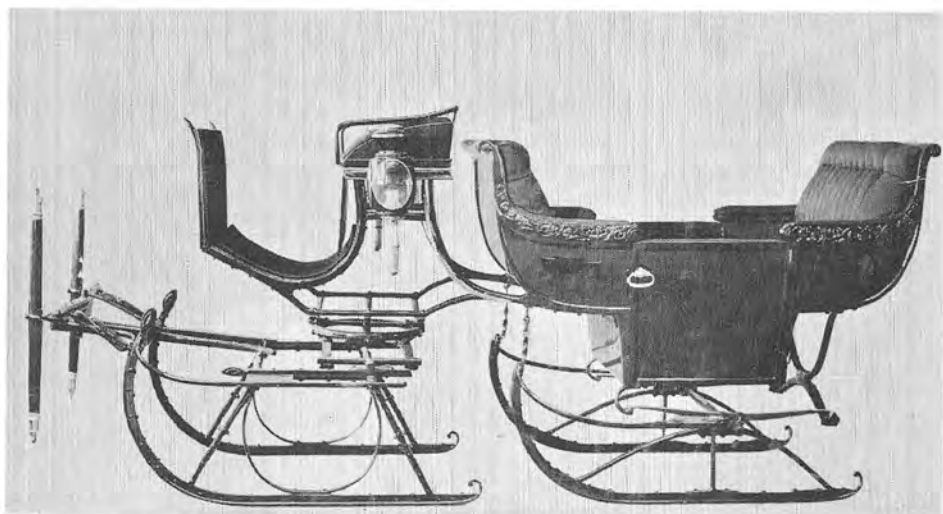
The firm rejected the demands, at first refusing even to discuss them, and the workmen struck. It was a peaceable strike until March, when fist-fights broke out between union men and imported strike-breakers, but in that same month it was ended through the mediation efforts of the mayor of Rochester. The shop rules to which the workmen had objected were abolished, and there was a wage increase of 12½ cents a day. More important, there was no aftermath of bad feeling.

Nevertheless, the strike was an indication that times had changed. The worker of 1882 was no longer the quasi-independent journeyman of thirty years back, looking forward to years of complete independence. He had become a wage-earner, and he expected to remain one. If management was paternalistic — and this management was benevolently so — it was like a father who finds it hard to believe that his son is growing up and considers his demands a sign of ingratitude. The strike came as a shock.

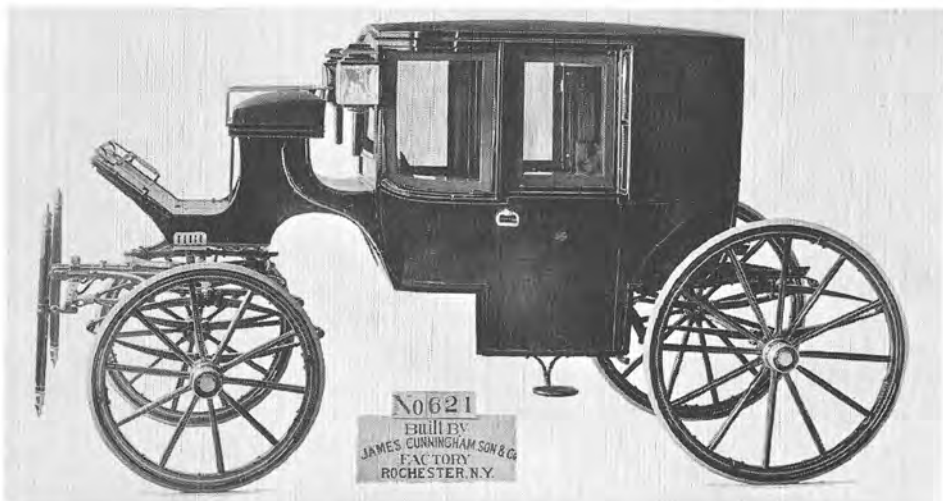
In some ways the shock was salutary. It cleared the air. Not until 1904 would there be another strike, the only other in the long history of the firm.

Also in 1882, the firm was incorporated as James Cunningham, Son and Company. It was now the largest industrial enterprise in Rochester, both in its plant area and in its capitalization of \$800,000. If it was not the biggest coach-works in the world, it rivalled the biggest.

By this time, James was at an age to retire. His son and son-in-law were taking over; but he had no wish to stop working. He was president of the new corporation and remained so until he died, but his real interest continued to be carriage-making. Partly crippled by an accident at the plant in 1884, partly by arthritis, he continued to go to the factory every day, visiting each department, talking to the workmen. He had known some of them for almost half a century. With unconscious flattery he treated even the youngest of the



VIS-A-VIS SLEIGH ON BOB RUNNERS, 1870



AMERICAN TOWN COACH OR FORMAL COACH, 1890

The coach through the years maintained its place as the "chief of every class"; while many vehicle builders could add the designation "carriage builder" after their names, few deserved the appellation "coach maker."

apprentices as if they shared his passion and talent for making carriages and improving the process of making them. In all his life very little else had interested him.

"Success is constitutional," said Emerson, who belonged to the same generation as James Cunningham, "a *plus* condition of mind and body: depends on power of work, on courage." Power of work, Emerson thought, came from concentration and routine, from choosing a single course and staying with it. Whether or not he had read this, James knew it without being told.

He died in 1886, and the workmen marched in a body to his funeral. One of them wrote a tribute which all the rest signed. It described him as a cheerful man, of great kindness. "Himself a workingman, he knew the wants of workingmen, he appreciated the difficulties and hardships to which they are exposed . . . He came to be looked upon, especially by those in his employ, as a kind and loving father. They felt he was their friend. They could ask help of him as of a brother. They regard his death as a personal bereavement."

III THE MIDDLE YEARS

WHEN Joseph Cunningham and Rufus Dryer took over the firm as President and Vice-President in the mid-eighties, Rochester had at last acquired its permanent character as a center for quality production. A high proportion of its labor force was skilled. That implied a degree of social stability greater than was to be found in most American cities. Rochester was a town of factories, but it never saw the prolonged, bloody clashes between labor and management that were typical of most industrial areas. Ethnic and religious, immigrants and native Americans, lived in an atmosphere of mutual tolerance. Discord was so minor as to point up the essential harmony. If life was a bit lacking in excitement, it was extraordinarily full of decency and good will.

Joseph Cunningham and Rufus Dryer were Rochesterians of their time. In some ways they complemented each



CALÈCHE, 1890

It was said of the Calèche, "It is not at all suited unless the stable be supplied with numerous carriages. It is intended simply for the most formal calling or for park work. The horses required were of the finest breeding, perfectly matched and with faultless manners."



GAME WAGON OR SHOOTING CART, 1900

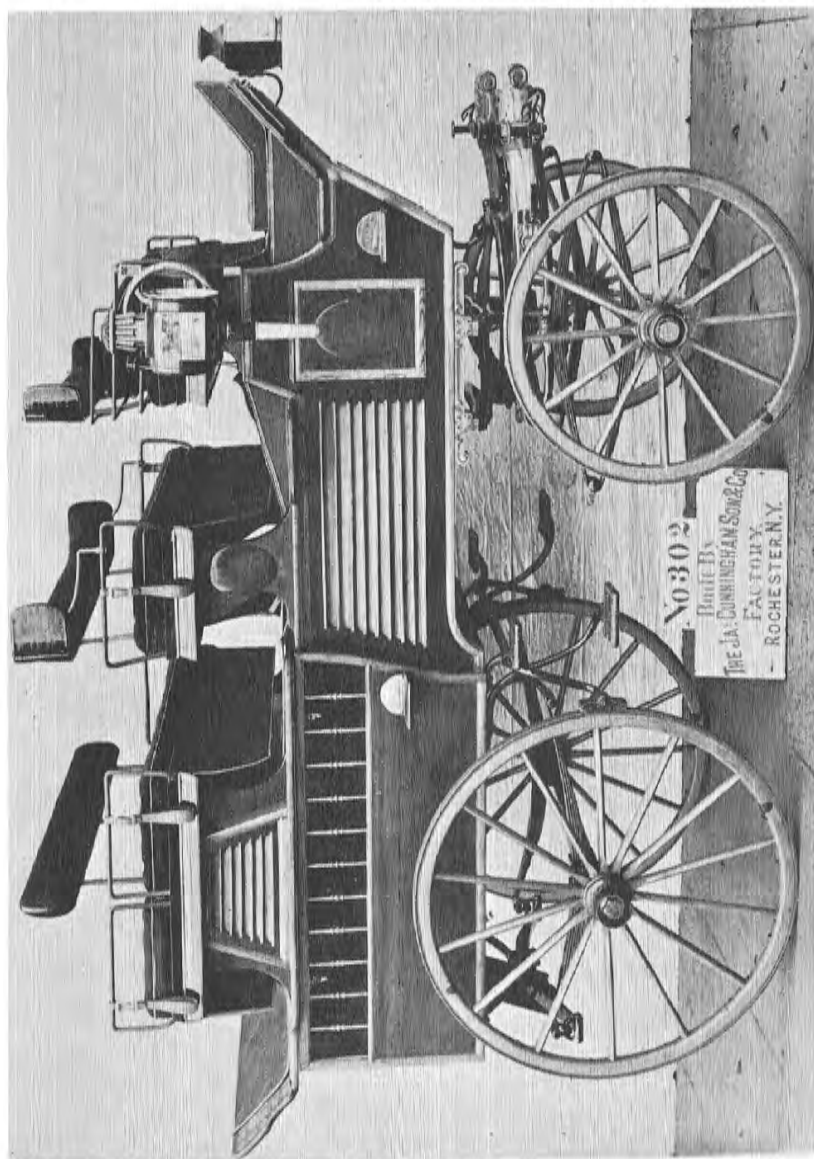
other. Temperamentally, Joseph Cunningham was a maker and builder, a "production man," as we say nowadays. Rufus Dryer had the financial acumen that was necessary to the survival of the firm in an age when the financier was increasingly coming to overshadow the producer. Joseph Cunningham and his family were drawn to the arts, especially to the German music and painting that attracted serious-minded people in the eighties. Rufus Dryer was a sportsman. He hunted; he shot quail in Georgia; he kept a series of yachts on Lake Ontario; and he looked for the farm he wanted to retire to one day, being in that respect a child of the fifties.

But the two men were alike in fundamentals. They understood each other. They were unmoved by the possible excitements of the era: they were not speculators or promoters; they made carriages. They remained aloof from politics, as most respectable people did in those days. They avoided personal publicity.

They were good friends. Their families lived next to each other on East Avenue and in the summer houses at nearby Charlotte, on Lake Ontario. On summer evenings they would drive themselves out to the lake in buggies with bright red wheels, hitched to fast trotters. They worked long hours and were apt to be late for dinner, but never for the opening of the factory in the morning. Toward the turn of the century they bought an island in Sodus Bay, forty miles to the east of Rochester, where their families passed the summer together and they spent the two weeks' vacation that was all they allowed themselves.

Sunday mornings after church, Rochesterians drove along East Avenue, under the high elm trees. In its outer reaches there were always drivers of carriages looking for an impromptu race. One driver would pull up abreast of another, coach dogs trotting demurely behind, and suddenly they were off . . . Most respectable people chose not to race, but they lingered to watch. Here, as elsewhere, a comfortable proportion of the carriages bore the Cunningham imprint.

It was the era of company picnics. A newspaper ac-



ROOF-SEAT BREAK, 1895

Originally a break was used in training horses to harness. It became a fashionable vehicle for country picnics and hunt-race meetings.

count written in July, 1887, conveys something of the atmosphere of one:

"One of the largest picnics of the season was that of the employees of James Cunningham, Son and Company . . . Employees to the number of several hundred assembled at the factory at 7:00 in the morning . . . At eight o'clock they formed into line and marched to North Avenue, headed by the 54th Regiment band. The Messrs. Cunningham and Dryer marched ahead of the procession at the desire of the employees . . . All the employees wore brown linen hats and the body made a fine appearance as it marched up Main Street. At North Avenue station they took cars by the Bay railroad to Sea Breeze, and thence by boats of the Irondequoit Navigation Company went to the Newport House to spend the day."

There were a baseball game, target shooting, races, and other athletic competitions. There were prizes for the successful competitors: young John Fulreader won an umbrella for the longest broad jump. He had joined the firm three years back, in 1884, at the age of fifteen. Eventually he would become its Treasurer and in that capacity stay with the firm into the fifties of the next century . . . The day was topped off with "an elegant dinner for five hundred people."

In the two decades since the Civil War "hands" had become "employees" — but not "personnel" or "labor force." Relations with employees were still on a personal basis. Men identified themselves with the firm and took pride in doing so. They formed the James Cunningham, Son and Company Mutual Aid Association to provide insurance against sickness and accidents. Their wives and daughters could join, and membership did not cease when an employee left the company.

With its fiftieth anniversary in 1888, Cunningham as a coachmaking firm had attained maturity. Its existence remained placid, like that of most of its upper-class customers, "the carriage trade." Joseph Cunningham continued to appear at the factory with his usual punctuality. Private customers and the proprietors of livery establishments remained loyal

to the firm. Rufus Dryer protected its financial interests, unmoved by the struggles and conflicts of the Trusts, hardly troubled by the depression of the nineties. He became a director of banks and industrial corporations as well as vice-president of Cunningham.

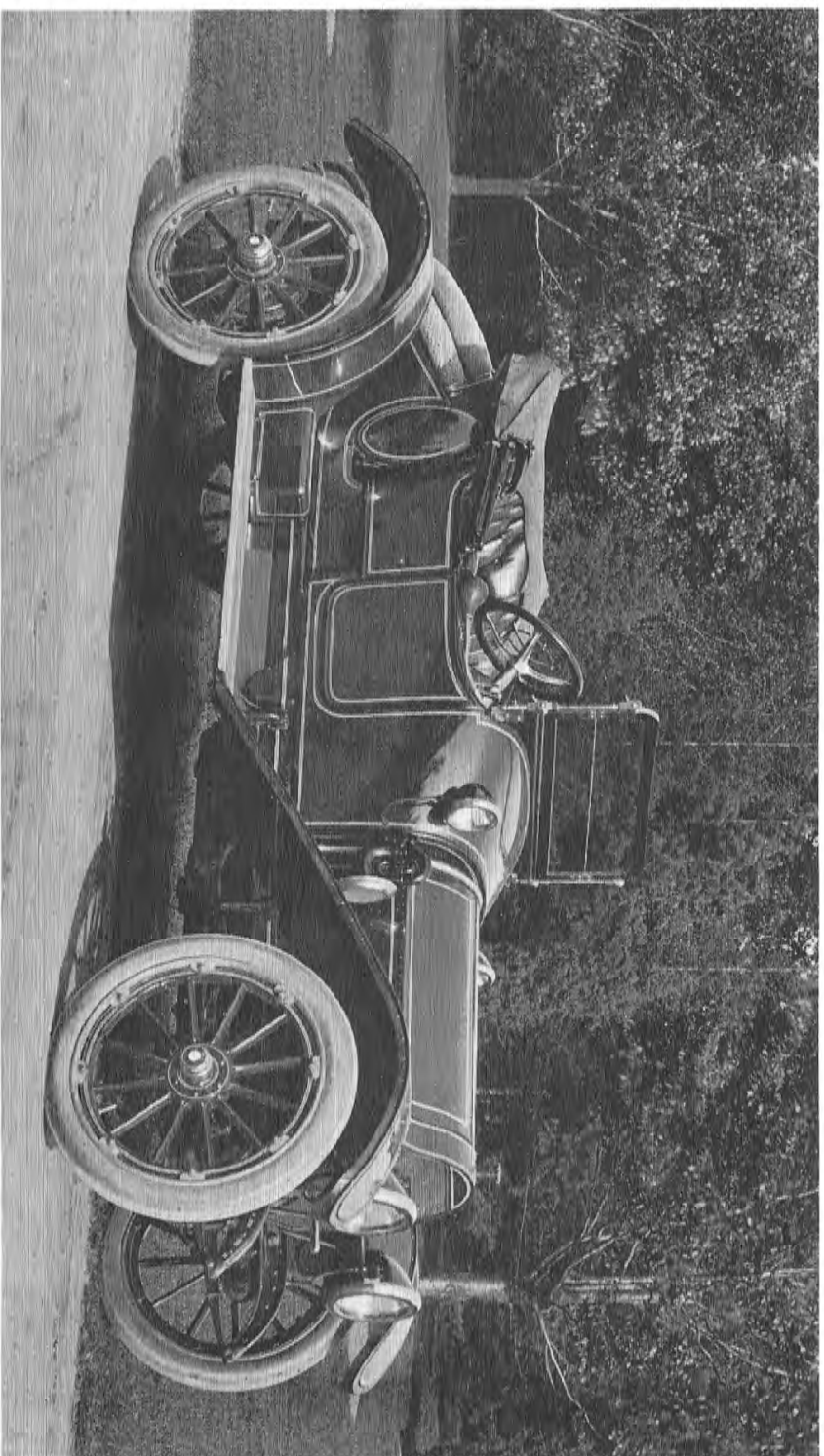
By the turn of the century, one of Joseph's sons, Augustine, was already in the business. Another son, Francis, was about to go to Harvard. Rufus' son, James, was graduating from the Massachusetts Institute of Technology. Predictably the three young men would take over one day from their fathers.

Except in one particular, there were no important developments in carriage-making. The exception was the tally-ho, the coach that Christmas cards have made familiar. A leisure class had grown up in America toward the end of the century. Because no tradition of aristocratic leisure existed in the United States, it borrowed one from England, and part of that tradition was coaching. The sons of industrialists and bankers learned to drive coaches, to ride to hounds and to live in large country houses. Cunningham made tally-hos for them.

The fact is more than an isolated historical item; when Cunningham came to make automobiles in the next century it would find most of its typical customers among the members of this class.

The firm continued to turn out carriages until 1915. Joseph Cunningham and Rufus Dryer retired in 1909, and the company, which had become a partnership, was re-incorporated. Augustine Cunningham was now President, James Dryer Vice-President, and Francis Cunningham Secretary and General Manager.

Their main interest lay in producing automobiles. It was clear that the days of the carriage were drawing to an end, and the transition from coach-making to automobile production seemed a natural one.



FOUR-CYLINDER LANDULET, 1913

IV THE AUTOMOBILE ERA

THE automobile first appeared on the American scene in the nineties, as an importation from Europe, and it was not regarded as having practical, workaday uses. Like yachts and tally-hos, it was an elaborate plaything for the rich. Its owners were referred to in the press as 'automobilists,' as one might say 'yachtsmen' or 'polo-players.'

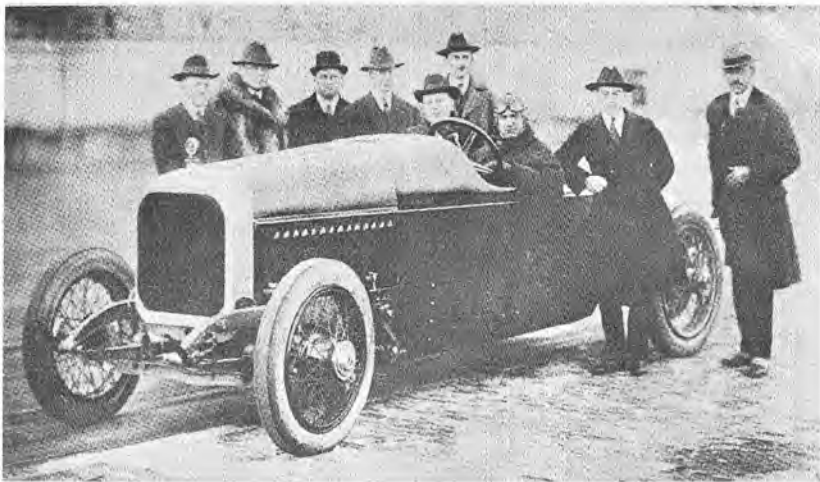
Nevertheless, it excited the curiosity of American mechanics, who began to construct imitations and adaptations of the European models. By 1900 there were eight thousand automobiles in the United States, and manufacturers had become interested in the possibility of producing cars in quantity.

Unfortunately for their purposes, the automobile of those days did not lend itself to mass-production. Early American makers tried to surmount this difficulty by imitating such features of European cars as could be made in quantity; but most of the best features could not be mass-produced. And there were other difficulties. Few manufacturers foresaw that the gasoline engine would become standard for automobiles. The overwhelming majority of cars at the New York Automobile Show of 1900 were electrics and steamers.

Electric cars were slow, and the law required that to operate a steamer a man must procure a steam-engineer's license.

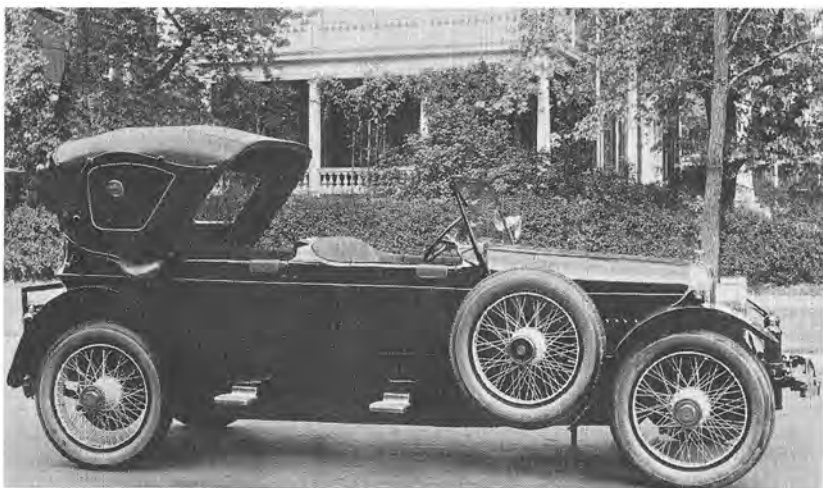
These difficulties might have been overcome fairly soon if it had not been for another: unlike Europe, America had no good roads. Even as late as 1908 it took Augustine Cunningham four days of hard driving to travel from Rochester to New York City, a distance of 370 miles. It was not until well after the first World War that the United States had a sufficiently developed road-net, and enough garages and service stations, to make cross-country travel feasible for inexpensive, mass-produced cars.

Most of the early manufacturers suffered the usual fate of pioneers: of the thousand companies that had started up around 1900, only fifteen survived as late as 1925.



STOCK 1919 ROADSTER

This stripped down V-8 was driven by Ralph DePalma (at wheel) at Sheepshead Bay track to set an AAA speed record of 10 miles in six minutes.



TOURING CAR WITH VICTORIA PANEL BOOT, 1920

Cunningham, although it was not interested in mass-production, was interested in making automobiles. In 1896 it had entered into negotiations with the Duryea brothers to manufacture their cars. These proved inconclusive, but at the turn of the century the firm actually produced some electric-powered buggies, mainly for purposes of experimentation.

In 1908 the firm embarked on automobile production, not for the popular market, but for customers of the sort that bought its carriages. The Cunningham car would be as good as the best European car, and it would be a development of the Cunningham tradition of fine coach-making. Necessarily it would be expensive: the cars made in 1908 and 1909 sold for \$3,500.

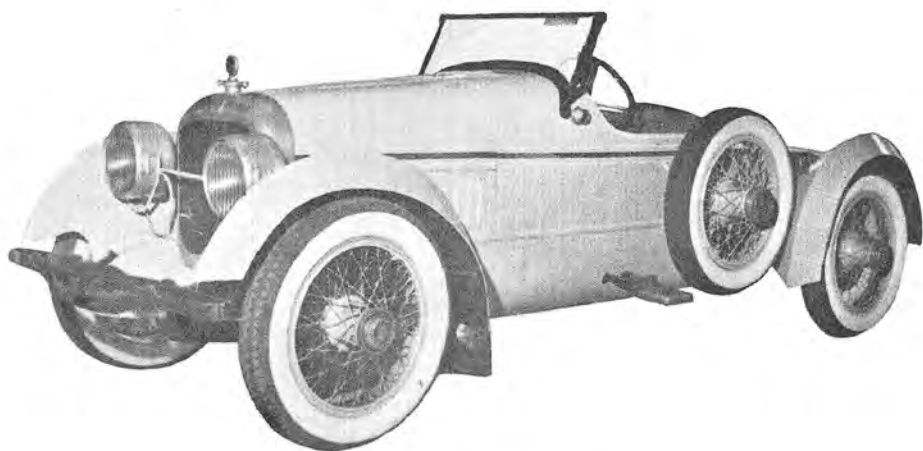
At first the company made only automobile bodies and assembled the rest of the car from engines, transmissions, axles, and radiators made by proprietary companies, but by 1910 it was producing all of these itself. Prices rose to \$4,500 and \$5,000.

In 1916 Cunningham produced the first automobile in America with a V-8 engine, and the Cunningham car became outstanding for its clean, classic lines. It was the first car to do away with running-boards, using instead steps of brass-framed aluminum. As in the carriage-making days, most of the metal- and wood-work was done by hand.

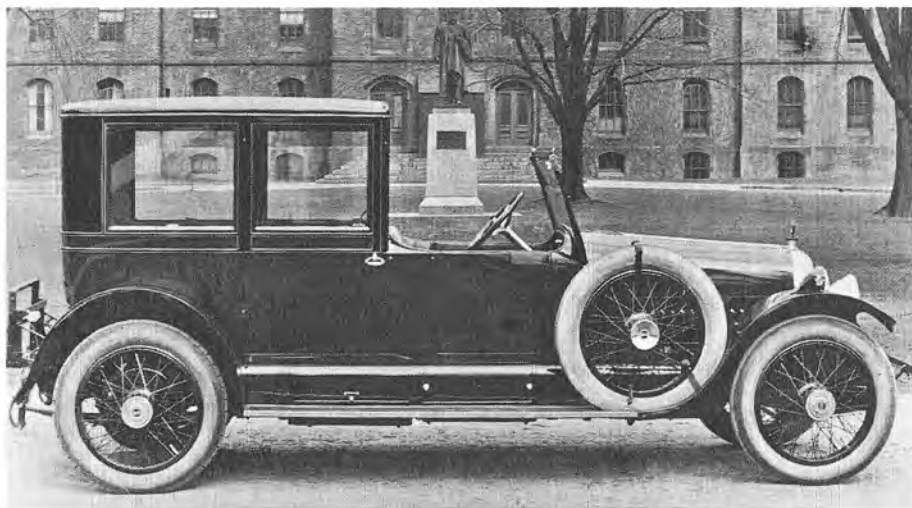
Owners did not entrust repairs to local garages. The company dispatched its own mechanics from Rochester.

After 1916 the car was improved as new mechanical development warranted, but not radically altered. There were no annual models; it did not go out of fashion. It remained a luxury car, for use in town — and for travel across country as well, being built to withstand the roads of the times and to negotiate the long distances between service stations. Part of its equipment for that purpose was a built-in air pump, with a tire hose which unreeled from beneath the seat.

By the end of the first World War, America began, belatedly, to construct the roads it needed. In 1919, New York State raised the speed limit for travel in open country from



DEPALMA SPEEDSTER, 1922
With L-head V-8 engine having 445 cu. in. displacement.



TOWN CAR, 1918

twenty to thirty miles an hour. Service stations appeared at strategic corners. Highways began to be marked; the practice of numbering them would not come in for several years.

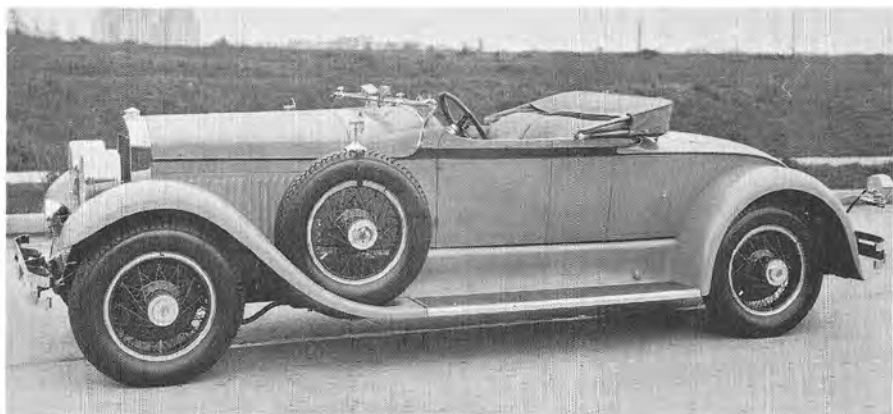
The automobile age began in earnest. In 1919 there were about seven million cars in the United States. In 1929 there were twenty-three million; thirty years later, seventy-four million. But in 1919, and for a long time to come, the proliferation of mass-produced cars did not appear to threaten Cunningham's market.

That year the famous racing driver, Ralph De Palma, made a record-breaking run in a Cunningham stock car at speeds over ninety-eight miles an hour. This stimulated sales of a roadster, at \$6,200. The average price for a town car was \$8,000; but cars made to order might cost as much as \$15,000. It was in one of the latter that Cunningham installed the first automobile radio.

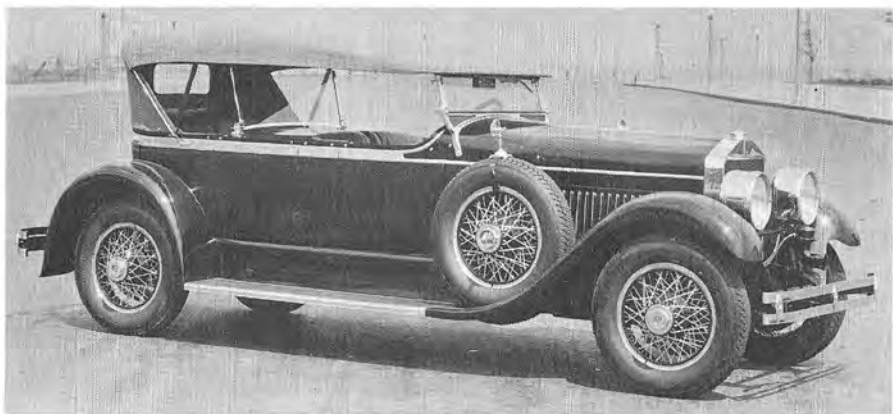
A new class of buyers appeared in the early twenties: Hollywood stars and directors, Latin-American millionaires and politicians, Japanese industrialists, even Chinese war lords. Cunningham satisfied their sometime capricious demands without vulgarizing its product; the firm's more conservative customers remained loyal to it.

Already the company had felt justified in increasing its capitalization from two million dollars to more than three million; but there was no attempt to compete with Detroit. Employing about 450 workers, Cunningham produced cars at an average annual rate of one and a half per worker, sufficient indication of its lack of interest in mass-production.

Detroit was in another world, a rather bleak world of assembly lines, speed-ups, and labor disputes. Thirty years later few of its customers would have any clear recollection of the cars they had bought in the twenties; none of its workers would remember it with anything resembling affection. By contrast, no one who owned a Cunningham car ever forgot it, and retired Cunningham workmen in the sixties still speak of the old plant with a certain fondness. If Cunningham could not afford to pay wages as high as some in



ROADSTER, 1929



TOURING CAR, 1930

With folding cowl and windshield for rear seat.

Detroit, nevertheless, 'it was a hell of a nice place to work.' 'The management knew you by name.' 'You felt at home there.' Like the men who had worked for James Cunningham almost a hundred years earlier, they grumbled a bit at exacting specifications, but 'you knew you were making the best car there was.'

In 1927, Lindbergh's flight from New York to Paris aroused new interest in aviation. In that optimistic year it seemed possible that the private plane would one day replace the automobile as a means of cross-country transportation; at any rate, the aircraft industry, which had been making slow progress after the first World War, felt the stimulus, and there was now a rush to make airplanes, as there had been a rush to make automobiles in the late nineties.

Cunningham foresaw correctly that the buyers of private planes would come from the same class of people that bought its cars and launched a subsidiary, the Cunningham-Hall Aircraft Corporation. This was not an attempt to produce quickly for an already existing market but rather one to prepare for the future. Sensible men were aware that there were tremendous obstacles in the way of developing private aircraft and that it would take time to overcome them. Experience would count.

The primary aim of the corporation was to build an airplane that would combine stability with speed. The first Cunningham-Hall plane, designed with these requirements in mind, was a modified biplane: the lower wing was considerably larger than the upper, and slotted, so that a current of air could be made to flow between its surfaces. This enabled the plane to land at speeds as slow as thirty-nine miles an hour. Its top speed was 110 miles an hour. It was first tested in the small town of LeRoy, New York; Rochester in 1929 still lacked a proper airfield.

Cunningham-Hall continued to make aircraft until 1938. Its X-14324, produced in 1934, was a low-wing monoplane, all metal, that cruised at 145 miles an hour, with a top speed of 165, somewhat faster than most private planes in use today. The company produced as well primary trainers, a six-

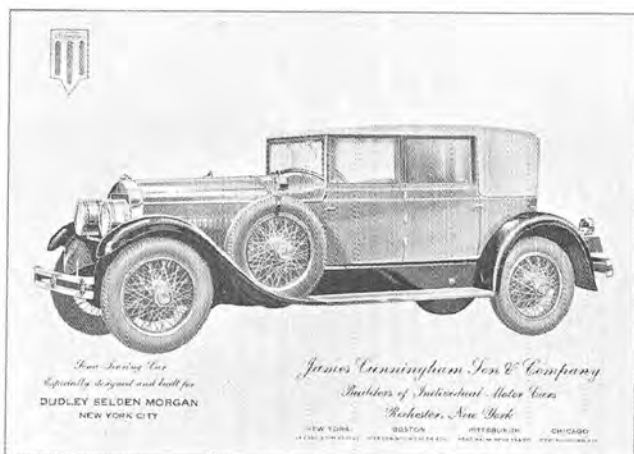
place cabin plane, other passenger and cargo craft, and experimental planes for the Army and Navy.

But these were depression years, and the difficulties of continuing were insuperable. The plant was not suited for making air-frames, and the market for private aircraft had almost disappeared. However, the experiment had not been entirely fruitless. Cunningham gained experience in using high-precision equipment and dealing with the close tolerances that manufacturing aircraft demands; and this would stand it in good stead two decades later.

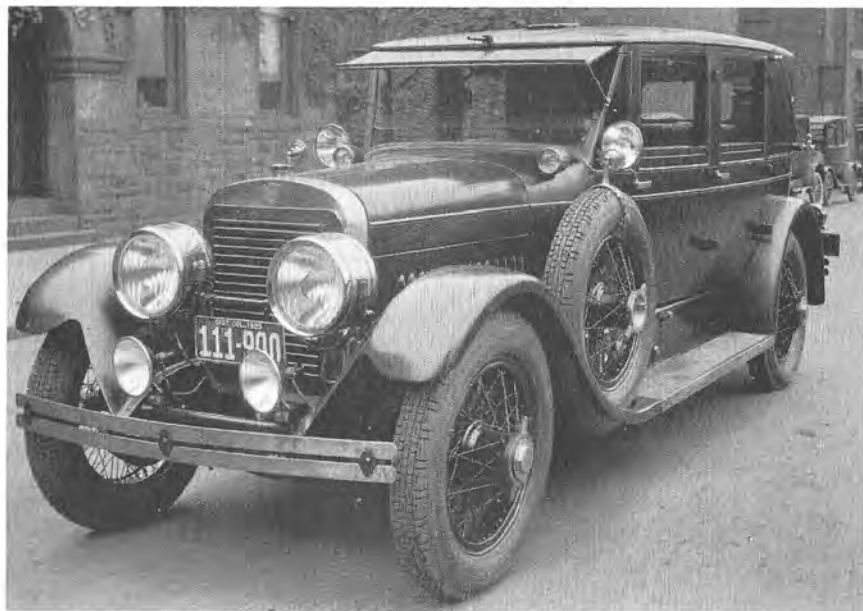
In 1928, when Cunningham, still a successful producer of automobiles, first ventured into plane production, very few expected the stock-market crash of 1929 and the general economic crisis that followed it. Probably no one accurately foresaw the social changes that would come about in the course of the Great Depression; and yet for Cunningham the first signs of change were beginning to be manifest.

Detroit was learning to make good cars, and with its strategy of turning out new models annually it was providing fashion as a substitute for style. Prestige now came from owning the newest car. Trading-in had become commonplace. Cunningham was aware of the challenge to its kind of excellence and made efforts to catch up with Detroit, but in the nature of things it could not hope to succeed. The point is that what Cunningham represented: luxury, elegance, high style, was becoming outmoded, and the firm was not equipped materially or temperamentally to adjust to the new trend. A cheap, mass-produced Cunningham was unthinkable.

It is not that Cunningham's potential customers were wiped out by the depression. There was still a fairly large class of people in the United States who could afford to buy expensive cars. What happened during the depression was that the habits and tastes of these people were modified: yachts, big country places, ostentatious living, became unfashionable. In the twenties, a Wall Street man who was unusually tall had ordered a custom-built limousine from Cunningham: the roof had to be raised six inches so that he could wear a top hat in dignified comfort. His counterpart in the



SEMI-TOURING CAR



SEDAN, 1922

Built for Air Force Major M. K. Lee on a 148 inch wheelbase chassis. This car had bullet-proof glass, a 50-gallon gas tank, an oil supply good for 5,000 miles, a Kellogg one-shot lubricator (pressing the foot pedal lubricated all chassis points) and triple windshield wipers. The dashboard contained a combination of 42 instruments, switches, and miscellaneous gadgets including many normally found only in aircraft cockpits. Among them were a tachometer, radio switch, fuel gauge, altimeter, voltmeter, ammeter, oil gauge, light switch, ignition switch, an imported French speedometer engraved with Major Lee's name, two motometers, aviator's compass, air speed indicator, etc. There were 8 lights beamed forward, 2 headlights, 2 "ditch" lights, 2 inside adjustable spotlights, and 2 sidelights. There were also parking, dome, dash and running board lights.

thirties solved the problem by discarding the top hat. He preferred to appear as indistinguishable as possible from people of middling incomes. One unreconciled woman on the North Shore of Long Island is said to have remarked, 'If this thing keeps up, we'll all be in the Buick class.' She was prophetic, though not in the sense she intended. The depression intensified a trend that was already operating, and it was that this trend, as much as the depression itself, that brought Cunningham's years of automobile-making to an end.

By 1931 the company had ceased to produce cars. For five more years it made bodies for other manufacturers; in particular, a town car body for Ford, which added \$2,000 to Ford's current price of \$600; and then in 1936 it was entirely out of the automobile business.

V THE SEARCH FOR A PRODUCT

AFTER 1936 it was a question of survival. An old and honorable firm had been overtaken by history. Cunningham might have allowed itself to be absorbed by a larger corporation. Its name would have conferred prestige. Or it might simply have closed its doors. The Cunninghams of the third generation, Augustine and Francis, and their cousin, James Dryer, had worked hard, and for the most part successfully, for more than a third of a century. They were no longer young, and it was plausible to argue that family firms were anachronistic, like carriages and the 'carriage trade.'

But the tradition of persistence was strong. Until the coming of the second World War, these men improvised. The firm made a variety of odd products: safety belts for aircraft, diving helmets, even belt buckles for Boy Scout uniforms. At times the payroll consisted of a small group of machinists and model-makers and a single night watchman.

With the coming of the second World War, Cunningham found a temporary role in defense production. The role was not new to the firm: during the Civil War it had made carriages for the Union armies; in the first World War,

ambulances and automotive windlasses for observation balloons. More significant had been its experience of producing armored and tracked vehicles.

Until the middle of the twentieth century, the United States customarily neglected its military establishment between wars. Congress made appropriations grudgingly, and materiel was allowed to become outdated. Moreover, military thinking tended to become cautious. Generals and admirals were apt to envisage the next war as a repetition of the last. Forward-looking young career officers needed considerable courage to buck the trend; they needed, as well, convincing, tangible means of demonstrating their new ideas.

In the nineteen-twenties a small group of officers in the Cavalry branch of the Army foresaw that the next war would be mechanized and, unlike the first World War, one of maneuver. Chaffee, Patton, and Levin Campbell are the most familiar names.

In 1927, members of this group, armed with a small appropriation, arranged with Cunningham to produce experimental tanks and other armored vehicles. What they wanted most was a fast light tank. The lumbering Christies of the first World War had been suited to trench warfare, but they were too slow for a war of maneuver. Their function had been to batter holes in a heavily held line. Light tanks, in contrast, would make rapid encirclements. They would have to travel long distances rapidly and without breaking down.

Cunningham went to work, and in March, 1928, its first tank was tested at Aberdeen, Maryland. Equipped with a revolving turret and armed with a 37 millimeter cannon and a .30 caliber machine gun, it traveled twenty miles an hour, more than three times as fast as any tank that had been produced up to that time.

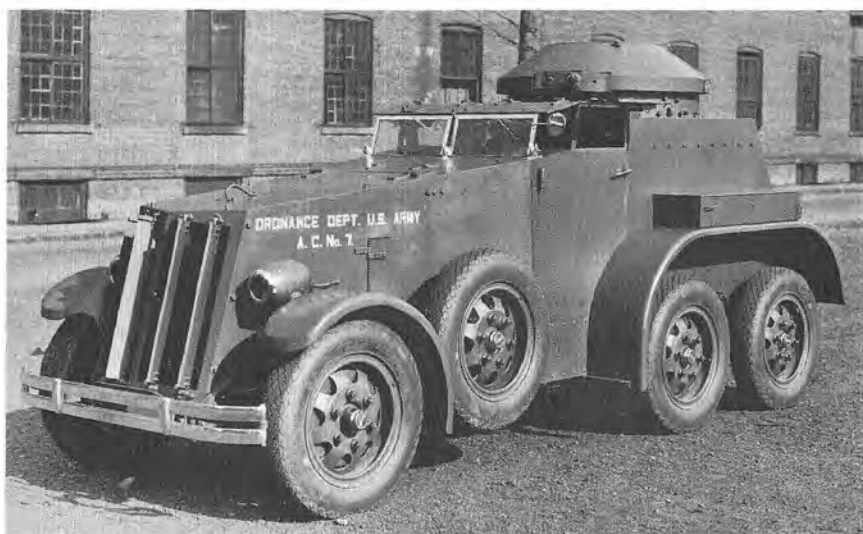
This was only a beginning. By 1933, Cunningham had developed a tank track, with light-weight rubber-block treads that allowed for greater speeds. In 1935 one of its tanks attained a cross-country speed of fifty miles an hour.

Cunningham also developed experimental half-tracks,



**NINE-TON CAVALRY TANK, MOUNTING A
37mm CANNON AND 30 CAL. MACHINE GUN**

This vehicle, driven by the V-8 engine, reached a speed of 25 miles per hour.



FOUR-WHEEL DRIVE T4 ARMoured CAR, 1930

In this 8500 lb. six-wheeled vehicle, the body or hull replaced the conventional chassis.

cargo-carriers, armored cars, and a weapons carrier for a 75 millimeter howitzer. Then appropriations for this purpose ceased, and when the firm resumed defense production five years later, it was no longer equipped to make vehicles.

Nevertheless, it had made an important contribution. The strategy for the reconquest of North Africa and Europe in the second World War was predicated on the employment of fast-moving armor. Cunningham had helped to demonstrate its feasibility.

In 1940 James Dryer retired. The corporation was dissolved the next year and replaced by a partnership, with Augustine and Francis Cunningham as co-partners.

Their first big job in the second World War was making mounts for .30 and .50 caliber machine guns. A defense production force that had consisted of six men in January, 1940, expanded to 360 in two years, and Cunningham won the Army-Navy "E" award. It was not done easily. In five years of relative inactivity the plant had begun to slip into obsolescence; the Cunningham brothers and the employees who had stayed with the firm during the lean years lost track of time as they struggled to re-equip and re-tool. Survivors of those days at the factory still recall them with a sense of wonder at the intensity of the effort they made.

By 1943 Cunningham was employing eight hundred men in a variety of war jobs. Most of its work consisted of sub-contracts for other producers, notably gear boxes operated by servo-motors for controlling wing surfaces, canopies, gunners' turrets, and tail surfaces in bomber planes. Aside from their military value, these had some significance for the firm; they were forerunners of its present electro-mechanical products.

When the war ended in 1945, Cunningham had the satisfaction of having made an honorable contribution, but essentially it was in the same situation it had been in during the late thirties. It lacked a product suited to its special talents.

Hopefully, in 1946 the firm produced small farm and garden machines: sickle-bar mowers, tractors, and rotary



SIX-PLACE, ALL-METAL CABIN BIPLANE, 1929



MODEL GA-36 LOW WING TRAINER, 1934

tillers. Fractional horse-power engines were in short supply at that time, existing machinery in the plant was suited to making them, and there was a post-war revival of interest in gardening; but by 1948 there were more than ninety other companies in the overcrowded field.

The next venture was more promising. Although trailer living had become a standard feature of the American scene, the internal arrangements of trailers tended to be clumsy and haphazard; apparently no manufacturer had given serious consideration to them. Cunningham made a survey and then designed and produced a complete line of plumbing fixtures for house-trailers.

By 1950 the company was enjoying a modest success, but an outsider might have been excused for regarding Cunningham as essentially a survivor from a more ample past, condemned to play a losing game: each success it scored would only attract the attention of larger competitors, better equipped to exploit the markets it had discovered. Already competition from mass-producers of plumbing fixtures was beginning to make itself felt, but even as this was happening Cunningham, almost by accident, found the product that it was suited by temperament and tradition to make.

This was the crossbar switch.

VI THE ERA OF AUTOMATION

THE simplest way to understand the Cunningham crossbar and switch and to see why Cunningham was ideally suited to develop it is to consider its evolution.

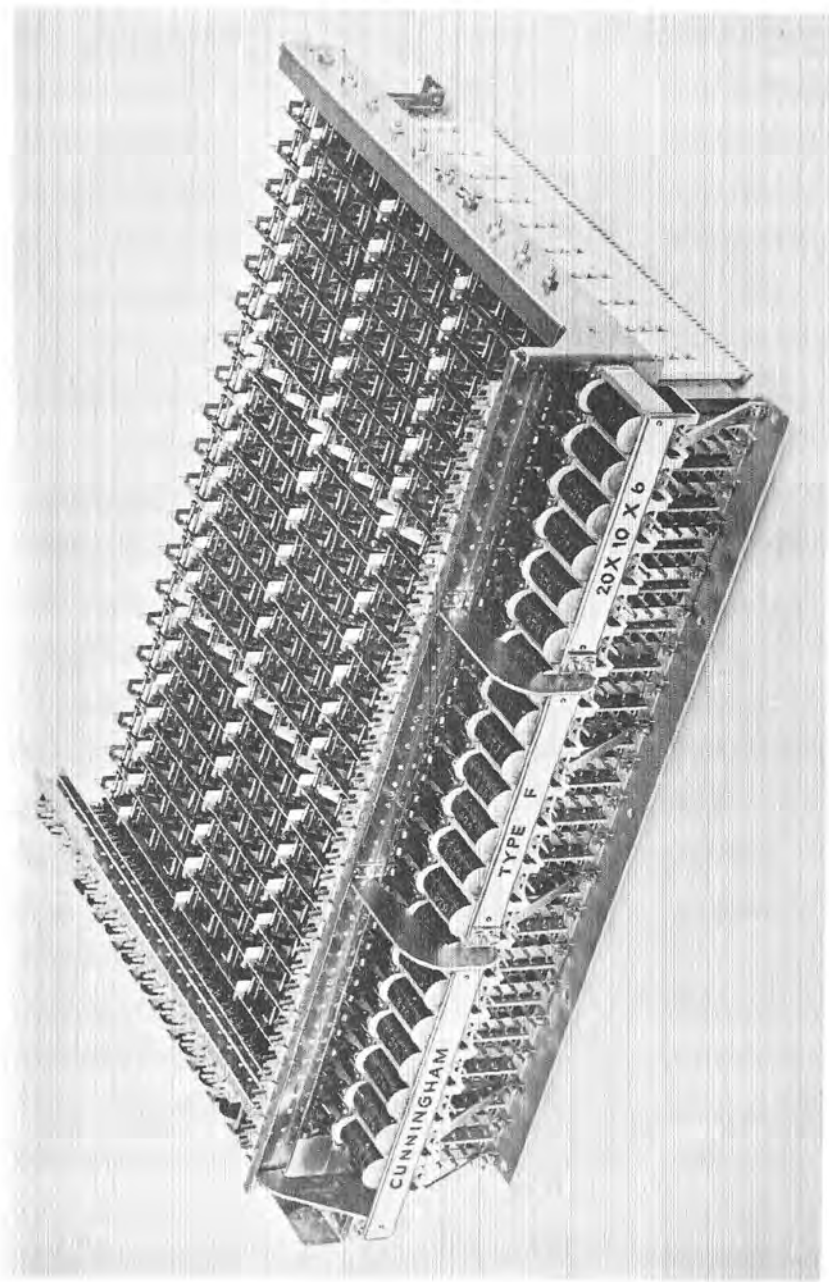
In 1946 a young electrical engineer, Andrew W. Vincent, left his job with Stromberg-Carlson in Rochester in order to devote himself to perfecting a small dial telephone system of his own devising. The heart of this system was the crossbar switch, and as Vincent worked he became more and more interested in the possibilities of the switch, until at last he was spending as much time considering them as he was on the system itself.

The switch that Vincent considered was — and still is — the ultimate development of electro-mechanical telephone switching. Early telephone systems had relied upon an operator at a switchboard to make connections between callers. As the number of subscribers mounted and as telephone systems were linked from town to town, the role of the operator became more complex, but her essential function did not change; it was simply to find and hold a path of communication through a network of wires. Various switching devices were called into being to assist the operator in this function, but she continued to play the primary role.

The crossbar switch changed that by performing this role automatically. When you dial a number nowadays you are, in effect, instructing a machine instead of a human operator to connect you with whatever telephone you are calling. In a nation that has eighty million telephones automatic switching is not merely labor-saving; it is a practical necessity.

It is worth remarking that the crossbar was not the first automatic switching device. Very early in the history of the telephone inventors had granted switching systems designed to replace human operators; some of these were actually adopted by telephone companies and are still in use, but they had mechanical and electrical drawbacks that the crossbar switch does not suffer from. Novelty of invention is often less significant than the subsequent refinement of what has been invented. The point has a bearing on what follows.

Vincent, trying to produce an improved dial telephone system, was only one of many engineers working with the crossbar switch; but in one respect he was unique. Instead of trying to build on the developments that had already been made, he went back to the fundamentals of the switch and considered them. To any competent electrical engineer these appeared obvious, but because Vincent did not take them for granted he discovered hitherto unsuspected potentialities in the crossbar. In the words of Alfred North Whitehead, "It requires a very unusual mind to undertake an analysis of the obvious."



CROSSBAR SWITCH

The ultimate result of Vincent's analysis was to be a crossbar switch unlike any other. Its qualitative differences would give it a reliability and a range of uses far beyond those of the ordinary crossbar. Most important, many of these uses would be outside the field of telephony.

But this is to anticipate and to run the risk of missing the point of the story. When Vincent, in 1950, was ready to look for a manufacturer, his intention was simply to produce an improved dial telephone system, and his improvements in the switch were incidental to that. The model of his crossbar switch that he brought to Cunningham was incorporated in a model of the dial system.

Francis Cunningham, the younger brother and co-partner of Augustine Cunningham, was receptive, and the brothers began to consider seriously the possibility of adding telephone equipment to their products. Their decision was made in 1951; the firm took over Vincent's initial designs and patent applications and hired him as a consultant.

Development work began in 1952, and as it got under way Andrew Vincent and Peter Cunningham, the son of Francis Cunningham, traveled through the United States interviewing potential customers. At this point the course of events took a characteristic, which is to say unexpected, direction. Manufacturers of telephone equipment, on whom the firm had looked as its likeliest customers, were polite but non-committal. "Come back and see us when you have a complete line." Companies outside the field of telephone equipment: men in the new television industry and makers of automatic machine tools and machines for gathering and processing information were far more encouraging. However, what aroused their interest was the crossbar switch rather than the dial system.

Their response gave a more specific direction to the work in the Rochester plant. Emphasis was put on developing the switch, and Vincent's title when he joined the firm shortly afterward was Chief Engineer of the Crossbar Switch Department.

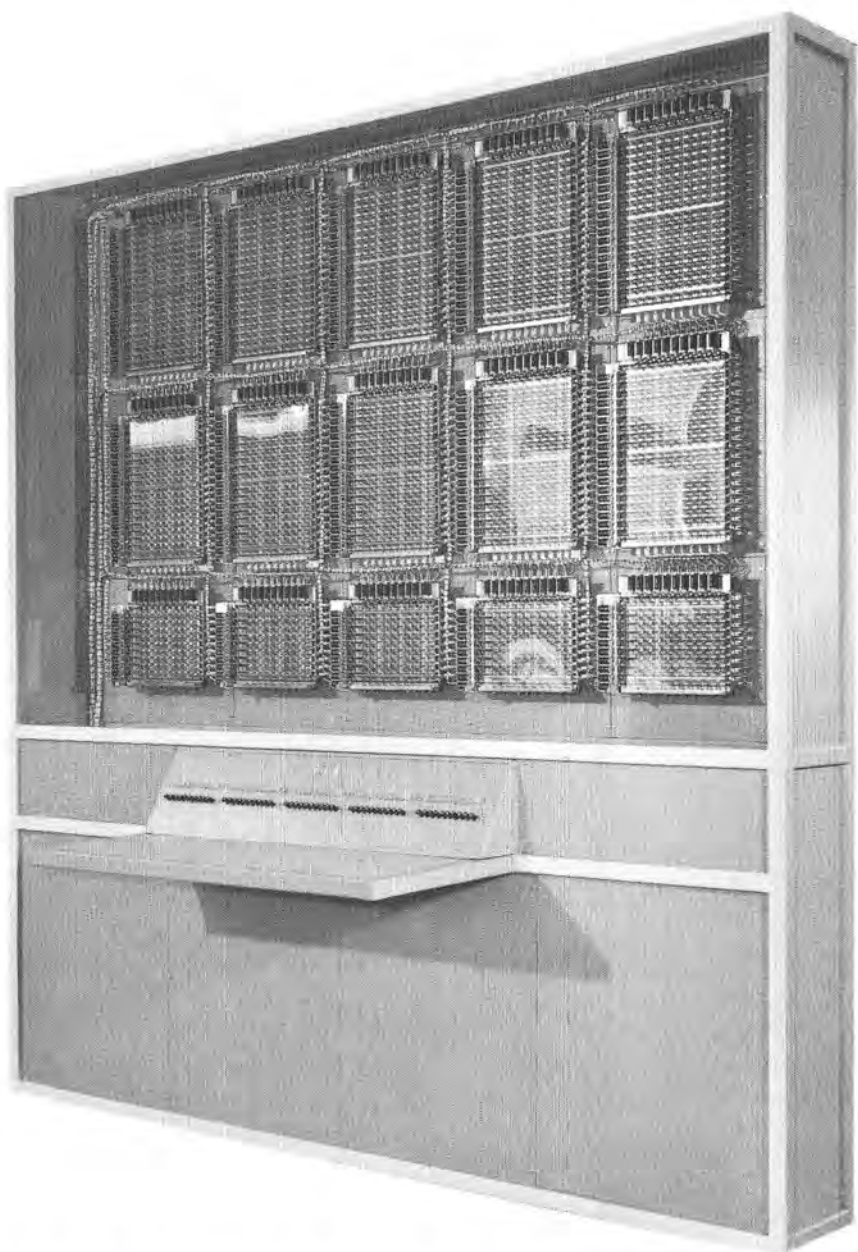
The first deliveries were made in 1953. In effect, if not in intention, the work thus far had been a pilot operation, and it revealed practical shortcomings. The sophisticated uses for which the Cunningham crossbar was potentially suited demanded refinement in design and technique of production.

Accordingly, at the end of 1953 Cunningham decided to reduce its production to a minimum in order to concentrate on designing and re-tooling. It was not an easy decision to make or adhere to. Re-tooling, especially, was expensive, and there was always the temptation to abandon the entire project on the grounds that it was too ambitious for a small firm; but against that were the tradition of persistence and the recognition that the Cunningham crossbar was unique.

It took three years to solve the design and manufacturing problems that had occasioned the setback, but during these years the firm was not simply catching up. In its restricted production it was creating prototypes of switching devices that it would later develop in more complex form.

By November 1956 Cunningham was ready to resume full-scale production, and this time it was altogether successful. The switch consistently met its customers' high standards of reliability and durability, and the list of these customers began to resemble a roster of America's leading business firms and scientific agencies. Throughout 1957 the volume of orders increased, at first steadily, then at an accelerated pace, and it has continued to increase ever since.

Seeing a Cunningham crossbar an expert would be struck by its versatility. In his language, it is unique in its ability to switch electrical information from low-level DC signals to 100 megacycles, and it does this reliably, at high speeds. He would be impressed, too, by the precision with which it is constructed and its consequent long life. A layman, ignorant of the uses to which it could be put and aware only of a glittering complexity of wires and metal, would nevertheless sense a certain elegance in the product. In the words of an electrical engineer too young to remember Cunningham carriages and automobiles, it is "the Rolls-Royce of crossbars."



CROSSBAR SWITCHING CONTROL FOR NASA TELEMETRY CENTER, HUNTSVILLE, ALABAMA

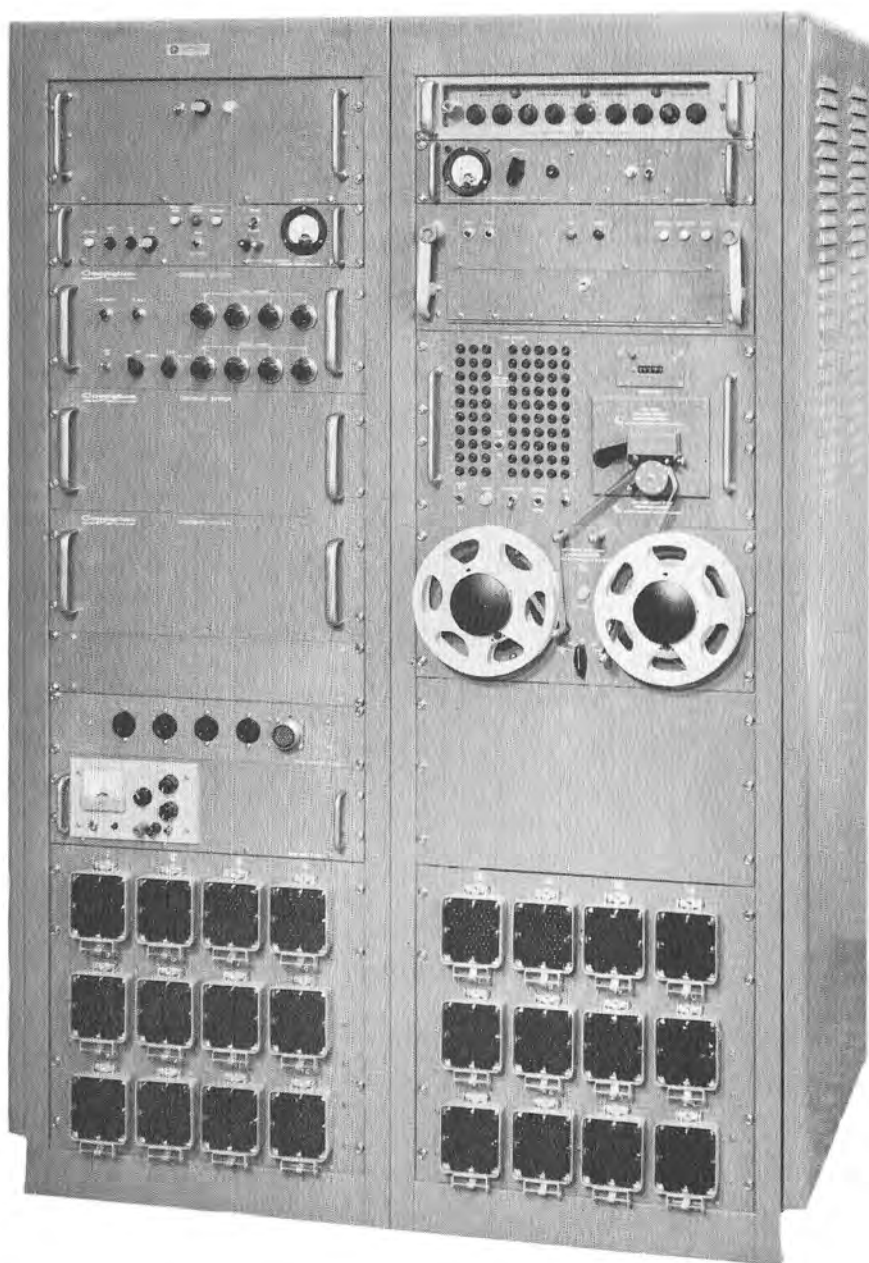
The Cunninghams of the third generation, Augustine and Francis, lived just long enough to see the first successful results of their struggle to maintain the firm. Augustine Cunningham died in 1957, Francis in 1958.

Brought up in an era of tranquility, when the prosperity of the firm had been taken for granted, and having successfully made the transition from carriages to automobiles, in middle age they had suddenly been confronted by adversity, and they had maintained the company in spite of it. Moreover, they had maintained it through a series of bewildering technological and economic changes and dislocations. James Cunningham had experienced change, but it was gradual and nearly always to his advantage; and his setbacks were short-lived. Joseph Cunningham and Rufus Dryer had lived in a monotony of fair weather: their lives coincided almost exactly with the most peaceful era civilization has ever known. If life had not always been easy for them, at least the world in their time had been predictable. In the world of Augustine and Francis Cunningham almost nothing was predictable except change itself.

With the death of Francis Cunningham in 1958, his son, Peter Cunningham, became the fourth president of the firm.

He had had that training that seems most suited to manage an enterprise in an era of change; that is, a training that confers experience in dealing quickly with a multiplicity of situations. Between the time of his graduation from Harvard in 1939 and his joining the firm after the second World War, he had worked on a newspaper, in an architect's office, in a forge, for a tool company, and at Bausch and Lomb, as a trainee in their export sales department. During the war he became station manager of the Leopoldville airport; in those days it was a key point on the route the Air Transport Command had established across Africa to by-pass the Axis powers. From Leopoldville he went on to Brussels, in 1944, to take over Melsbroek airport for the A. T. C. As a member of the firm after the war he had lived through its years of making garden machines and trailer equipment.

But if he had gained the basic practical experience that



AUTOMATIC TESTING SYSTEM FOR MINUTEMAN MISSILE

manufacturers have always needed, when the firm decided to make crossbar switches he was confronted with the necessity of extending his education in a way that is so characteristic of modern industry that it is worth dwelling upon. He had to learn a new and complex language, that of a highly specialized technology. His decisions and plans, ultimately his success as a producer, would depend on his skill in using it.

For James Cunningham the problem had hardly existed. He was his own engineer; in fact, he had begun his career in the role of technician and picked up the language of commerce as he progressed. In the second generation, Joseph Cunningham and Rufus Dryer, having served an apprenticeship under James Cunningham, were altogether competent to make decisions based on a knowledge of the fine points of carriage-making. It was not until the coming of the automobile that the specialization of the functions of management and the engineer began to create difficulties in communication; and these were by no means insuperable. But as technology became more complex its language became more remote from everyday experiences; moreover, it was now a language not only of the engineer but that of the customer, for the customer was no longer a private citizen who wanted a fine carriage or automobile. He had become a technologist himself, and he spoke for a corporation, in the language of technology.

The problem was not simply to learn to discuss the crossbar switch in its own language. As a manufacturer, Peter Cunningham had also to be able to translate back from that language into the ordinary language of business, to conduct a dialogue in two languages at once. This was what he was learning in the course of his travels with Andrew Vincent.

The skill was essential not only to the commercial success of the enterprise but to the development of the switch itself. The Cunningham crossbar was not first invented, as a static thing, then produced. It evolved in the course of a long dialogue between engineers and producers and users, a dialogue that still continues.

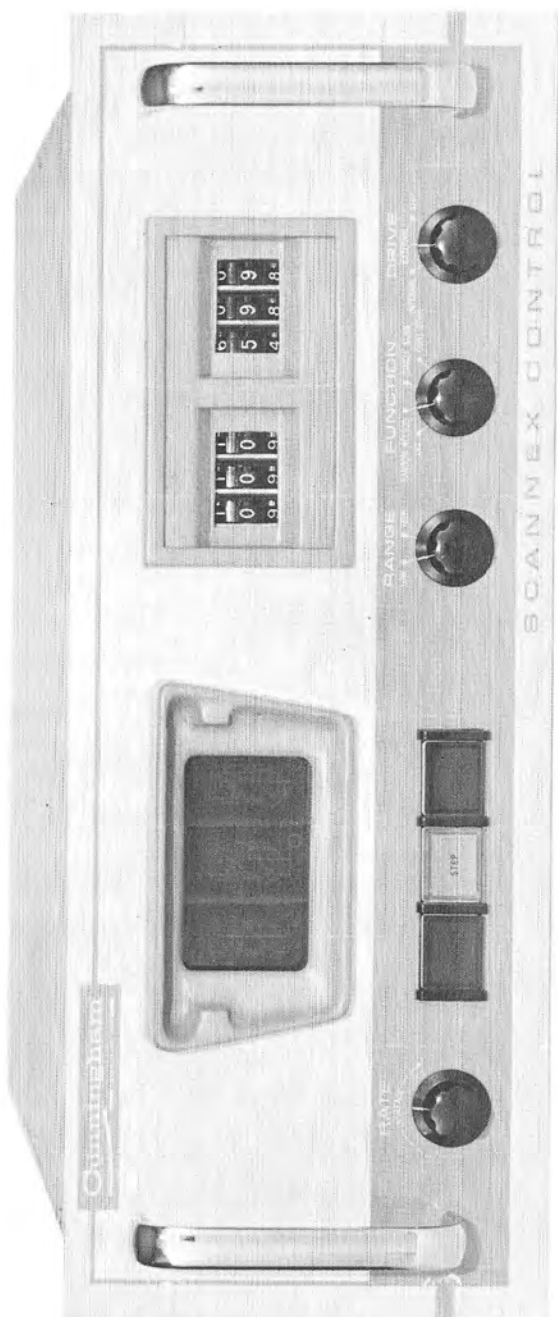
One early result of this dialogue was especially significant. In 1957, as part of an attempt to arouse wider interest in its crossbar switches by demonstrating some of their applications, the firm produced for the first time a crossbar system; that is to say, an automated machine using a crossbar for its switching. The function of this particular system was to read and record the computations of an analog computer. It was successful, and the firm began to make more systems, with a diversity of uses.

The need to communicate had further consequences. One of them was the creation within the plant of a group of applications engineers, who serve as liaison between the firm and its customers. These have made Cunningham known as a solver of switching problems. Another was the publication of technical bulletins and a small technical journal, *Select and Hold*, in which the nature and developing uses of crossbar switching are explained. And as a result of the success of its systems, the firm organized a group of systems engineers, more or less distinct from a group that concentrates on the switch itself. The switch is still the heart of the enterprise, but like most successful products it has continued to react upon and develop the purposes of its makers.

The reader who has stayed with the story this far will be aware of a certain irony. An old firm that appeared to be doomed in an era of mass-production because of its tradition of quality-production survived and prospered in a later era, that of automation, precisely by virtue of this tradition.

How can we account for it? The reason seems to lie in the nature of automation. The essence of automation is feedback: an automated machine responds to and even modifies its circumstances. Clearly a mechanism that does this must be more refined, more reliable, more of a "quality product" than one whose activities can constantly be guided and corrected by a human operator. It was not accidental that the Cunningham crossbar switch was developed by a small firm with a tradition of quality production.

Conceivably a large firm might have done it. It might have transformed the ordinary crossbar switch into some-



SCANNEX SWITCHING SYSTEM FOR TRANSDUCER DATA ACQUISITION

thing so superior in quality and so adjusted to the various demands of its users that the net result was a new and unique product; but the odds would have been against it. What was needed was something more than the application of funds and engineering skill. It was the psychological commitment of the whole firm to the enterprise and an ability on the part of management as well as its engineers to enter directly into the dialogue between producer and consumer.

EPILOGUE

AS ITS operations expanded Cunningham felt the need for a modern plant, one designed specifically for its requirements as a manufacturer of crossbars. It reconnoitered for a new location and found one in Honeoye Falls, fifteen miles to the south of Rochester. There, in 1961, on a twenty acre site that had formerly been devoted to nursery farming, the firm built its present factory.

There is something appropriate about this setting, an old upstate village surrounded by open farming country. The factory, for all its modernity, has a look of belonging. One is not surprised to see, across a meadow, from the entrance to the plant the stable in which the nursery company kept its horses. James Cunningham, visiting Honeoye Falls today, would find most of it recognizable.

Perhaps he would be temporarily bewildered by the complexity of the crossbar and the diversity of its applications. Cunningham crossbars are used by banks for closed-circuit television systems, by makers of automatic machine tools, transistors, printed circuits, and computers, by oil and power companies and aircraft manufacturers, by government and university laboratories, to direct processes undreamed of in his lifetime. They go to the launching sites at Cape Kennedy and to the space flight centers in Huntsville, Alabama, and Houston, Texas. (James Cunningham, returning on horseback from a successful selling tour was glad to use the moon simply for its light; he did not regard it as a target.)

But if he found the novelty of the modern enterprise bewildering, it would not be for long, for he would be quick to recognize the principles underlying it: respect for good workmanship, perseverance, insistence upon quality. These principles were his own. It would not surprise him to learn that they continue to sustain his descendants.

NOTES AND ACKNOWLEDGMENTS

The purpose of this informal narrative has been to tell the story of Cunningham rather than to explain each of its products in detail.

Readers who are moved to learn more about carriages and coach-making may be surprised by the paucity of books on the subject; of these the best are *The Evolution of Horse-Drawn Vehicles*, by James Reid, and *Carriages and Coaches*, by Ralph Straus.

If historians have neglected coach-making, literature about the history of the automobile is super-abundant. Mark Sullivan has provided a good short account of the early days in, *Our Times*, vol. I.

We have drawn mainly on company records for our discussion of Cunningham aircraft, armored and tracked vehicles, and the lesser products of the firm. There is need for a history of the development of private aircraft and for a non-technical account of the evolution of the Armored Force.

Automation is the subject of various popular books, but there is no general agreement as to a definition of the word, which did not come into use until 1948. We have used it simply in the sense of technology based on self-regulating machines. Automated machinery is not new: Leonardo's windmills, constructed with revolving turrets and vanes, so that they always faced into the wind, were "automated." But automation as a basic means of production, calculation, and

communication is so new that we have still to come to terms with it.

There is no non-technical literature on the crossbar switch; engineers who are interested will find its applications and potentialities described in Cunningham publications.

The lay reader should be told that the crossbar switch is electro-mechanical, not electronic; which is to say, not the "latest" development in switching. The point is that as Cunningham has developed it, it has actual and potential uses for which it is better suited than purely electronic devices. Radio is a later development than the telephone, but we continue to rely on the telephone for most of our communications.

No one can explore the past of Rochester without recognizing that Blake McKelvey's comprehensive history of the city is the basic work on the subject.

For the facts of Cunningham's history which relate directly to the firm and its personnel, we have relied on company records and, to some extent, on contemporary Rochester newspapers; however, the latter are not always accurate, especially as to dates. We have also drawn on the recollection of various members of the Cunningham and Dryer families and employees of the firm, notably James Dryer, Miss Leora Dryer, Mrs. Francis Cunningham, Frank W. Fulreader, Humbert Porreca, Samuel P. DeMato, Henry Gessner, Mrs. Jerold Foland, and Andrew W. Vincent. To them, as well as to those we have not mentioned, thanks are due.

Thanks are due also for the technical help and suggestions of Dr. McKelvey, Theodore Steinway, Jan Christian Mayer, Harry Turner, among others; but none of the people we have named should be held to account for any of the opinions we have expressed in the course of this narrative. The responsibility for them is ours.

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